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(54) Title: EFFERVESCENT BEVERAGE PRODUCT AND METHOD FOR DRINKING THE SAME

(57) Abstract: An effervescent beverage having an effervescent gas dissolved therein is described. The beverage remains pressurized until consumed and may have a smooth and silky texture when a sparingly soluble gas is used.

EFFERVESCENT BEVERAGE PRODUCT AND METHOD FOR DRINKING THE SAME

FIELD OF THE INVENTION

The present invention is directed to a beverage product that comprises a container, dispenser, and a pressurized beverage having a soluble and/or a sparingly soluble effervescent gas dissolved therein. More particularly, the present invention is directed to a beverage product that preferably remains pressurized until substantially all beverage has been consumed.

BACKGROUND OF THE INVENTION

Carbonated beverages such as mineral water and soft drinks are very popular with consumers. Carbon dioxide is readily soluble in water, (has a solubility of 1.69g Kg^{-1} in water at 20°C and atmospheric pressure), is inexpensive and safe. When carbon dioxide is mixed under pressure with a drinkable liquid in a container, a substantial portion of the gas remains dissolved in the drinkable liquid when the container is opened to the atmosphere and depressurized. Once the container is opened and depressurized, the consumer may then drink the beverage which typically generates a sharp and prickly sensation in the mouth when, for example, swallowing. Moreover, since conventional carbonated beverages are consumed when depressurized, the consumer must use a cumbersome drinking technique that, at the very least, requires at least one hand and a pouring action, or a drinking straw and suckling action in order to drink the carbonated beverage.

Gases that are sparingly soluble in water, such as oxygen or nitrogen, have not been successfully employed in a drinkable liquid in the same manner as more soluble gases, such as carbon dioxide.

Particularly, when oxygen is added to a drinkable liquid under atmospheric conditions, or a container holding a pressurized oxygenated beverage is opened to the atmosphere, a substantial proportion of the oxygen contained in the beverage and packaging will rapidly escape from the beverage and packaging and be dispersed in the surrounding atmosphere, resulting in a poor-tasting and flat (i.e., non-effervescent) beverage. Moreover, since such oxygenated beverages are depressurized prior to consumption, the consumer cannot drink the beverage without at least using one hand and a pouring action, or a drinking straw and a suckling action.

It is of increasing interest to develop a beverage which is good tasting, not flat, effervescent, and smooth and silky in texture, particularly when a sparingly soluble gas is employed. It also is desirable to develop a beverage whereby the beverage may be consumed without requiring the use of at least one hand and a pouring action, or a drinking straw and suckling action, thereby making consumption of the beverage much easier than consumption of conventional beverages, regardless of the type of gas employed (i.e., soluble and/or sparingly soluble). The invention herein, therefore, is directed to an effervescent beverage that, at the very least, is: (a) smooth and silky, or (b) consumable without requiring the use of at least one hand and a pouring action, or a drinking straw and a suckling action, or (c) both. In an especially preferred embodiment, the invention is also directed to a beverage that may be consumed from a beverage product without requiring a hand squeezing action on the container to force the beverage out of the beverage product.

ADDITIONAL INFORMATION

Efforts have been disclosed for making beverages with oxygen. In JP 64-27458, a health drink with oxygen is described, whereby the package having the health drink is opened and depressurized before the health drink is consumed.

Other efforts have been disclosed for preparing an oxygenated beverage. In U.S. Patent No. 5,378,480, a method for preparing an oxygenated cocktail is described, whereby the cocktail must be consumed within two minutes of preparation and not under pressure.

Still other efforts have been disclosed for making a drink having improved flavor. In JP 1168269, a water drink having a propellant and an atomizer is described.

None of the information above describes a beverage product whereby a beverage is in a container having a dispenser or valve to dispense the beverage as a water-continuous and effervescent beverage. Moreover, none of the information above describes a pressurized beverage product comprising a beverage that is not only effervescent when dispensed, but also capable of generating a smooth and silky sensation when consumed. Even further, none of the information above describes a liquid-continuous (e.g., water-continuous) beverage whereby the consumer may drink or consume the beverage without requiring the use of at least one hand and a pouring action, or a drinking straw and suckling action to drink the beverage, regardless of the type of gas employed.

SUMMARY OF THE INVENTION

In a first aspect, the present invention is directed to a pressurized beverage product comprising:

(a) a pressurized beverage within a pressure resistant container, the beverage comprising a soluble gas, a sparingly soluble gas, or a mixture of gases dissolved therein; and

(b) a valve in a position to seal the container, the valve, when opened, suitable to dispense the beverage as an effervescent beverage to a mouth of a consumer

wherein, internally, the container has a headspace pressurized to less than 25 bar (gauge as measured at 10°C) with the soluble gas, sparingly soluble gas, or mixture thereof.

In a second aspect, the present invention is directed to a method for drinking with the pressurized beverage product of the first aspect of this invention.

Beverage, as used herein, is defined to mean a liquid suitable for use in mouth or consumption by humans, including a liquid which may generally be classified as pharmaceutical or medicinal in nature. Effervescent beverage, as used herein, is defined to mean a beverage capable of emitting small bubbles of a gas, and preferably, a beverage which generates a smooth and silky sensation when swallowing, and a beverage which may have a fine, smoke-like appearance when being dispensed as a consequence of the bubbles of gas. Pouring action is meant to mean the conventional mechanical action taken by a consumer when drinking a beverage, like soda, from a bottle (i.e., including head tilting and arm lifting).

Beverage product, as used herein, is defined to mean a product that is suitable to dispense a water-continuous liquid, and therefore, a product that preferably does not comprise an atomizer. Smooth and silky, as used herein, is defined to mean the feeling or sensation generated by a beverage comprising bubbles suspended therein, wherein at least 80.0% of the bubbles that are suspended therein have a diameter that is less than 0.5 mm, and preferably, less than 0.15 mm. Liquid-continuous beverage means not a fragmented and gas-continuous beverage such as a beverage dispensed from a container having an atomizer.

BRIEF DESCRIPTION OF THE DRAWINGS

The subject matter which is regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, may be best understood by reference to the following description taken in conjunction with the accompanying drawing figures in which:

Figure 1 depicts an illustrative beverage product of the present invention;

Figure 2 depicts an illustrative actuator means for use with this invention;

Figures 3 and 4 depict an illustrative valve for use with this invention, top view and bottom view, respectively.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

There is no limitation with respect to the type of beverage that may be used in the beverage product of the present invention other than that the beverage is one which may be consumed by humans. Typically, such a beverage is aqueous

based or substantially pure water. Examples of the aqueous-based beverages which may be used in this invention include flavored water, with and without minerals (e.g., isotonic sports beverages and energy drinks), vegetable juices, like carrot juice and fruit juices like tomato, strawberry, blueberry, lemon, lime, orange, pineapple juice and mixtures thereof. Other illustrative beverages that may be used in this invention include alcoholic drink (e.g., beer), diet drinks, protein-based drinks (e.g., milk or soy-based), coffee, tea, soda and those beverages which may generally be classified as pharmaceutical or medicinal in nature, including a cough suppressant and a mouthwash. In a preferred embodiment, the beverage is citrus (preferably pulp free) in nature, and most preferably, one comprising at least one flavor (natural and/or artificial) selected from the group consisting of lemon, lime, strawberry and orange. In an especially preferred embodiment, the beverage comprises at least 85.0% by weight water, based on total weight of the beverage, whereby the water comprises less than 0.5 ppm of chlorine to assist with, among other things, beverage stability and flavor.

In another especially preferred embodiment, the beverage employed in the beverage product of the present invention comprises from 0.001 to 0.5%, and preferably, from 0.005 to 0.4%, and most preferably, from 0.01 to 0.2% by weight preservative, based on total weight of the beverage, and including all ranges subsumed therein. Typically, such preservatives include food grade preservatives such as those generally classified as benzoates and sorbates, with mixtures of potassium sorbate and benzoate being especially preferred.

Regarding the pressure resistant container that may be used in this invention, such a container is one that may withstand pressurization of at least 0.5 bars (gauge) at 10°C. Such a pressure resistant container can be metal containing, like an aluminum comprising container or plastic containing, like a polycarbonate or

polyester (e.g., polyalkylene terephthalate) comprising container. Often, the container used in this invention is one which is from 30.0 ml to 3.0 liters, and preferably, from 200.0 ml to 2.0 liters, and most preferably, from 300.0 ml to 1.0 liter, including all ranges subsumed therein.

The volume of beverage present in the pressure resistant container typically is from 30.0% to 96.0%, and preferably, from 40.0% to 95.0%, and most preferably, from 50.0% to 90.0% by volume beverage, based on total volume of the pressure resistant container, including all ranges subsumed therein.

The total gauge pressure within the headspace of the pressure resistant container above the beverage is typically from 0.5 bar to 25 bars, and preferably, from 1.0 bar to 15.0 bars, and most preferably, from 2.5 bars to 9.0 bars at 10.0°C, including all ranges subsumed therein.

Upon taking a drink (i.e., consuming beverage) from the beverage product of the present invention, the final pressure (Pf) within the headspace (within 1.0 to 5.0 seconds of taking the drink, in the absence of shaking) of the pressurized vessel and above the beverage will be greater than atmospheric pressure until substantially all beverage has been consumed. Therefore, the pressure in the headspace of the beverage product will change approximately in accordance with the ideal gas law (assuming no gas is directly discharged from the headspace) such that:

$$(Pf) = Pi \cdot \frac{Tf}{Ti} \cdot \frac{V}{V+\Delta V}$$

wherein Pf is as previously defined, Pi is the pressure in the headspace prior to the dispensing of effervescent beverage, Ti is the temperature of the gas in the headspace before beverage is dispensed and Tf is the temperature of the gas in the headspace after beverage is dispensed, V is the volume of the head space just before beverage is dispensed and ΔV is the volume of effervescent beverage dispensed out of the beverage product and to the consumer for consumption.

In an especially preferred embodiment, the pressure within the headspace meets the criteria defined above and greater than 0.05 ml of gas is expelled from the beverage product for every 1.0 ml of effervescent beverage expelled from the same (when the absolute pressure and temperature outside the beverage product are 1.0 bar and 10°C, respectively). Therefore, when the valve is opened, the effervescent beverage is discharged or dispensed under pressure, and the beverage product preferably remains pressurized until substantially all beverage has been dispensed from the beverage product.

Regarding the soluble and/or sparingly soluble gas which may be used in the beverage product of the present invention, such a gas is only limited to the extent that it is one which may be used in a beverage consumed by humans. An illustrative list of the gases which may be employed in the present invention includes carbon dioxide, oxygen, nitrogen, nitrous oxide, hydrogen, gaseous hydrocarbon, a noble gas (e.g., argon, helium, neon, krypton) or mixtures thereof, including compressed air. In an especially preferred embodiment, however, the preferred effervescent gas used in this invention is oxygen, or compressed air comprising at least 78.0 percent nitrogen, at least 20.0 percent oxygen, and less than 2.0 percent argon by volume. In another especially preferred embodiment, when the beverage of the present invention is not smooth and silky (e.g., when

carbon dioxide is the sole gas employed), the beverage product does not comprise an atomizer.

It is noted herein that if desired, gas adsorbing materials (with or without their own packaging) may be added to the beverage in order to minimize oxidation, or to store extra gas which is released within the product, thereby ensuring that the beverage, when discharged from the beverage product, is effervescent. Moreover, when a more soluble gas is used in a mixture with a less soluble gas, (e.g., when carbon dioxide is employed in a mixture with oxygen), it is generally preferred that the more soluble gas has a partial pressure in the headspace of less than 5.0 bars, and preferably, not exceeding 1.0 bar partial at ambient temperature.

Regarding the valve or dispenser used in the beverage product of the present invention, such a valve often includes, or is associated with, actuator means. There is no limitation with respect to the actuator means that may be used in this invention other than that the actuator means are usable by a consumer for consumption of an effervescent beverage. Typically, an illustrative actuator will be shaped and positioned such that it may be engaged by a consumer's finger, hand, mouth, teeth, or combination thereof in order to deliver effervescent beverage for consumption. Preferably, the actuator means selected will allow for consumption of the beverage by the consumer without requiring the use of at least one hand and a pouring action and a drinking straw and a suckling action.

Turning to Figure 1, an illustrative beverage product 10 is shown with reusable cap 11 in place. The beverage product 10, as illustrated, comprises a container 12, headspace 10a and a dispenser (i.e., aerosol valve), not shown, which is high-throughput and seated beneath actuator means 14 (which is connected to container 12 via actuator means collar 14a). Connected to container 12 at container

neck 12a is the dispenser not shown but connected to the container neck 12a by, for example, a crimping technique or screwing mechanism. The dispenser, not shown, is operatively connected to the actuator means 14 such that when cap 11 is removed and when the actuator means 14 is moved from a resting position, as illustrated by arrow 16, the same causes the dispenser not shown to open so that effervescent (and pressurized) beverage 18 may be dispensed to the mouth of a consumer (not shown) through actuator opening 20 illustrated in the shape of a tee or cross. Actuator means 14 may be moved by the consumer by pressing finger-lip 22 (e.g., a portion for contact with a finger) or simply by moving the same by gripping with the mouth, teeth or both (not shown) at actuator mouth portion 24.

Subsequent to moving the actuator means 14 and opening the dispenser or aerosol valve (not shown), effervescent beverage 18 is drawn through dip tube 26 via dip tube opening 26a and dispensed through actuator opening 20 for consumption.

Turning to Figure 2, actuator means 14 is shown in an open position exposing dispenser nozzle 28. The actuator means 14 is connected to actuator means collar 14a via hinge 30, and rests on dispenser nozzle 28 when operatively connected to the same. Figure 3 depicts dispenser 32 (top view) with dispenser nozzle 28 having a plurality of effervescent beverage dispensing channels 34. Figure 4 depicts a bottom view of dispenser 32 with draw nozzle 36. Thus, when actuator means 14 is moved from a resting position, effervescent beverage 18 is dispensed through dip tube 26 which is connected to draw nozzle 36 to thereby transport effervescent beverage through plurality of dispensing channels 34 of dispenser nozzle 28 and through actuator opening 20 for consumption.

It is noted herein that optionally, dispenser 32 may be operatively connected to an atomizer not shown to produce a gas-continuous beverage. Preferably, however, an atomizer is not used and the effervescent beverage of the present invention is water-continuous, especially, when carbon dioxide is employed. Moreover, in an especially preferred embodiment, dip tube opening 26a faces the portion of the container 12 that is on the opposite side of finger-lip 22.

When assembling the beverage product of the present invention, commercially available bottles able to withstand the pressures encountered during the filling process to produce products at the pressures described herein may be used. Such bottles are typically sold by suppliers like CCL Industries, Inc. The aerosol valves (i.e., dispenser) and dip tubes employable in this invention may also be purchased commercially, although aerosol valves with a plurality of dispensing channels are often preferred. Furthermore, the actuator means may be purchased commercially; however, a preferred actuator is oval-like, having a top portion (i.e., portion with the actuator opening) with dimensions that are from 0.20 cm to 3.0 cm by 0.05 cm to 2.5 cm, including all ranges subsumed therein. At the time of assembly, in no particular order, the desired beverage is fed into the bottle, the valves are fastened on to the bottles and the predetermined gas is fed into the bottle through the valve. Optionally, the gas may be added in the form of a liquefied propellant.

The following examples are provided to facilitate an understanding of the present invention. The examples are not intended to limit the scope of the accompanying claims.

Example 1

Water (300ml) at 10 ± 0.5° C was poured into a strong polyethylene terephthalate ("PET") bottle of 28 g mass and 520 ml brimful capacity. The bottle was then left to equilibrate in a temperature-controlled bath also at 10 ± 0.5° C. The headspace above the water in the bottle was flushed with oxygen for 5 to 10 seconds, and then the aerosol valve was placed quickly over the neck of the bottle, thus sealing the bottle from any loss of oxygen or influx of air. The aerosol valve was then held firmly in place by means of a screw cap with a small hole cut in the center in order to allow the stem of the valve to be accessible.

More oxygen was then added from the regulated supply oxygen through the stem of the aerosol valve until a pressure of 4 bar was reached. The bottle was then shaken to ensure that the gas inside was at the same temperature as the water, and the bottle was topped up to 4 bar with more oxygen. This was necessary because the temperature of the gas when first injected into the bottle is somewhat higher than 10° C.

The sealed and pressurized bottle was then placed in a temperature controlled bath at 10 ± 0.5° C for 5 minutes to equilibrate, the sample being shaken every 30 seconds to ensure good contact between the gas mixture and the water in the bottle.

Subsequent to the bubbles, resulting from the shaking, rising to the surface, the beverage was then discharged under water that was at a temperature of 21 ± 1° C. The stream of discharged fluid was observed as it left the bottle against a black plastic sheet, and it was noted whether or not there was a visible, fine, smoke-like effervescence.

Example 2

Beverages were prepared by mixing, in no particular order, the following components:

Ingredient	Weight Percent (%)
Potassium Sorbate	0.005 - 0.06
Potassium Benzoate	0.01 - 0.03
Sodium hexametaphosphate	0.02 - 0.1
Chelator (EDTA)	0.001 - 0.03
Sugar	4.0 - 6.0
Flavor*	0.01 - 0.1
Citric Acid	0.10 - 0.20
Water	Balance

*Commercially available beverage flavor, like passion fruit or peach flavor.

The beverages of Example 2 were added to a container in a manner similar to the one described in Example 1 to produce effervescent beverages having fruit flavors.

What is claimed:

1. A pressurized beverage product comprising:

(a) a beverage within a pressure resistant container, the beverage comprising a soluble gas, a sparingly soluble gas, or a mixture of gases dissolved therein; and

(b) a valve in a position to seal the container, the valve, when opened, suitable to dispense the beverage as an effervescent beverage to a mouth of a consumer

wherein, internally, the container has a headspace pressurized to less than 25 bar, gauge, with the soluble gas, sparingly soluble gas, or mixture of gases.

2. The pressurized beverage product according to claim 1 wherein the beverage comprises oxygen, nitrogen, or a mixture thereof.

3. The pressurized beverage product according to claim 1 wherein the beverage comprises oxygen, compressed air or a mixture thereof.

4. The pressurized beverage product according to claim 3 wherein the compressed air comprises at least 78.0% nitrogen, at least 20.0% oxygen, and less than 2.0% argon.

5. The pressurized beverage product according to claim 1 wherein the pressurized beverage product is pressurized from 1.0 bar to 15.0 bar, gauge.

6. The pressurized beverage product according to claim 1 wherein the pressurized beverage product comprises water with less than 0.5 ppm chlorine.

7. The pressurized beverage product according to claim 1 wherein the beverage is juice, tea, coffee, an alcoholic drink, a diet drink, a protein-based drink, soda, mouthwash, a sports drink, an energy drink, or a pharmaceutical or medicinal drink.

8. The pressurized beverage product according to claim 7 wherein the beverage is a citrus beverage.

9. The pressurized beverage product according to claim 8 wherein the citrus beverage is free of pulp.

10. The pressurized beverage product according to claim 1 wherein the beverage comprises suspended bubbles and at least 80% of the suspended bubbles have a diameter that is less than 0.5 mm.

11. The pressurized beverage product according to claim 1 wherein the beverage is liquid-continuous.

12. The pressurized beverage product according to claim 1 wherein the beverage is water-continuous.

13. The pressurized beverage product according to claim 1 wherein the container has a volume from 30.0 ml to 3.0 liters and the volume is occupied with 30.0% to 96.0% beverage.

14. The pressurized beverage product according to claim 1 wherein the beverage is smooth and silky upon consumption.

15. A method for consuming a beverage comprising the steps of:

(a) contacting an actuator of a pressurized beverage product with a mouth of a consumer; and

(b) moving the actuator from a resting position to release beverage out of the beveraged product and into the mouth of the consumer, the beverage being effervescent and comprising suspended bubbles wherein at least 80% of the suspended bubbles have a diameter that is less than 0.5 mm.

16. The method for consuming a beverage according to claim 15 wherein the beverage product has a pressurized headspace and pressure in the headspace, upon releasing of beverage, changes in accordance with the ideal gas law wherein:

$$(Pf) = Pi \cdot \frac{Tf}{Ti} \cdot \frac{V}{V+\Delta V}$$

and Pf is headspace final pressure, Pi is headspace pressure before beverage is released, Ti is gas temperature in the headspace before beverage is released, Tf is gas temperature in the headspace after beverage is released, V is volume in the headspace before beverage is released and ΔV is volume of beverage released from the beverage product.

17. The method for consuming a beverage according to claim 16 wherein greater than 0.05 ml of gas is expelled from the beverage product for every 1.0 ml of beverage.

18. The method for consuming a beverage according to claim 15 wherein the beverage is juice, tea, coffee, an alcoholic drink, a diet drink, a protein-based drink, soda, or a pharmaceutical or medicinal drink.

19. The method for consuming a beverage according to claim 15 wherein the beverage is:

(a) smooth and silky, or

(b) consumed without using at least one hand and a pouring action or a drinking straw and a suckling action, or

(c) both (a) and (b).

20. The method for consuming a beverage according to claim 15 wherein the beverage is consumed without requiring a hand squeezing action on a container.

21. A method for consuming a beverage comprising the steps of:

(a) contacting an actuator of a pressurized beverage product with a mouth of a consumer;

(b) moving the actuator from a resting position to release beverage out of the beverage product and into the mouth of the consumer

wherein the beverage product comprises a container and, internally, the container has a headspace pressurized to less than 25 bar, gauge, with the soluble gas, sparingly soluble gas, or mixture of gases

Fig.1.

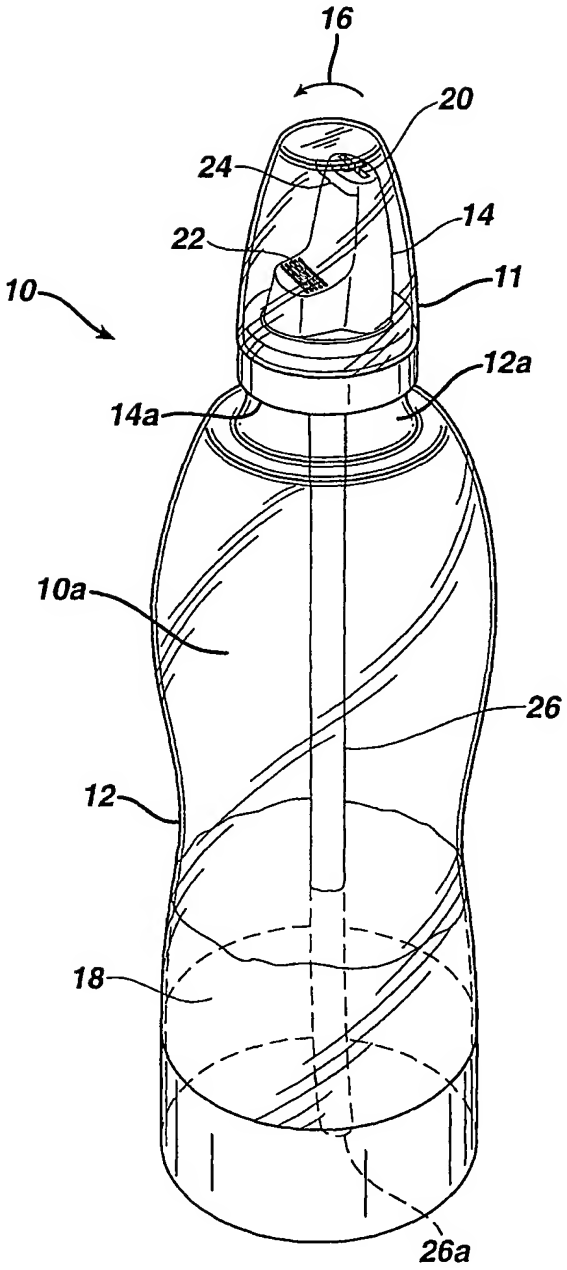


Fig.2.

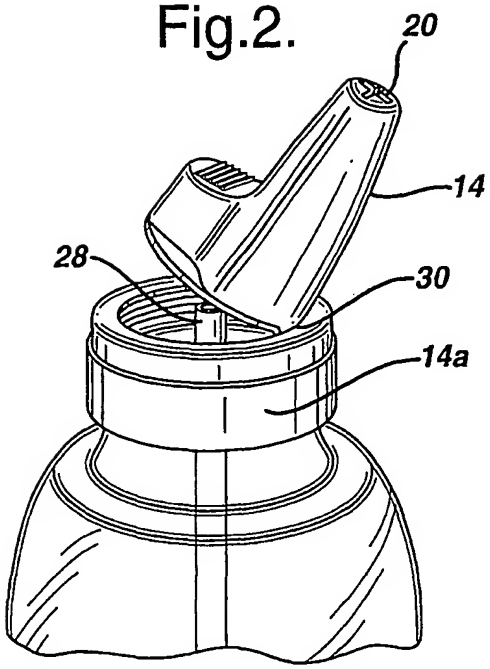


Fig.3.

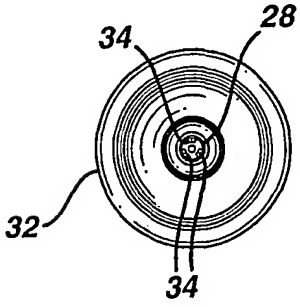
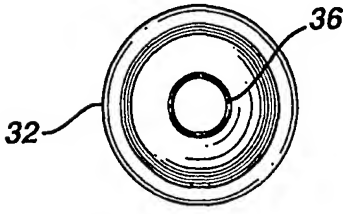


Fig.4.



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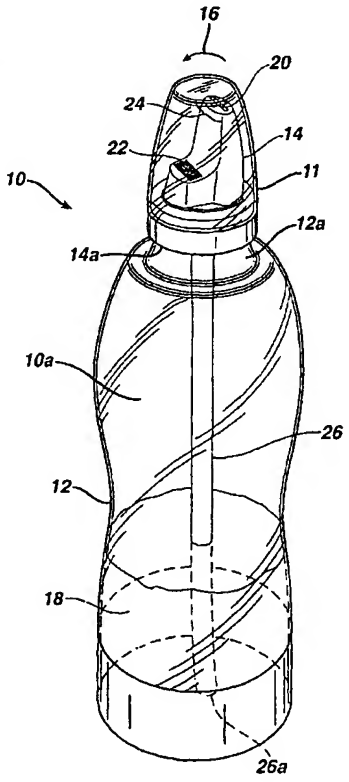
(54) Title: EFFERVESCENT BEVERAGE IN A CONTAINER AND METHOD FOR DRINKING THE SAME



(57) Abstract: An effervescent beverage within a pressure resistant container with a discharge valve and having an effervescent gas dissolved therein is discribed. The beverage remains pressurized until consumed and may have a smooth and silky texture when a sparingly soluble gas is used.

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 02/02345

A. CLASSIFICATION OF SUBJECT MATTER
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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
PAJ, WPI Data, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 015, no. 500 (C-0895), 18 December 1991 (1991-12-18) & JP 03 219864 A (OOZEKI SYUZO KK), 27 September 1991 (1991-09-27)	1,2,5,7
Y	abstract the whole document	3,4,6, 8-14
X	US 4 752 018 A (RUDICK ARTHUR G ET AL) 21 June 1988 (1988-06-21)	21
Y	column 5, line 28 - line 31 column 5, line 43 - line 47	15,16, 18-20
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 October 2002	18. 10. 2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bridault, A

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
L	DATABASE WPI Section Ch, Week 199145 Derwent Publications Ltd., London, GB; Class D16, AN 1991-329101 XP002135570 & JP 03 219864 A (OZEKI SAKE BREWING), 27 September 1991 (1991-09-27) abstract	1,2,5,7
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP 02/02345

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

As a result of the prior review under R. 40.2(e) PCT,
no additional fees are to be refunded.

1. [X] As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[X] The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-14

   Beverage product characterised by the gas and pressure in the headspace.

2. Claims: 15-21

   Method of consuming a beverage.

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int[redacted]tional Application No
PCT/EP 02/02345

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(54) Title: DISPENSER WITH EFFERVESCENT BEVERAGE PRODUCT

(57) Abstract: A beverage product that comprises a dispenser and a pressurised beverage. The dispenser has a container for holding the beverage and a valve. The beverage has a sparingly soluble effervescence inducing gas dissolved therein and is held under a gaseous pressure in the head space of the container that is sufficient to cause the beverage to be discharged from the dispenser as an effervescent fluid when the valve is open.

DISPENSER WITH EFFERVESCENT BEVERAGE PRODUCT

This invention relates to a beverage product that comprises a dispenser and a pressurised beverage with a sparingly soluble effervescence inducing gas dissolved therein. The dispenser has a valve that can be opened to allow for the beverage to be discharged as an effervescent fluid.

Background and prior art

Carbonated beverages such as mineral water, soft drinks and iced teas are very popular with consumers. Carbon dioxide is readily soluble in water, it has a solubility of 1.69 g kg^{-1} in water at 20° C and atmospheric pressure), and it is cheap, widely available and non-harmful. When carbon dioxide is mixed under pressure with a drinkable liquid in a container a substantial proportion of the gas remains dissolved in the drinkable liquid when the container is opened to the atmosphere. That enables the container to be resealed and stored for a short time if desired, with minimal deterioration to the gaseous liquid. These carbonated beverages are usually contained in aluminium cans or bottles made of glass or plastic.

The presence of a large amount of carbon dioxide in solution in a beverage produces a distinctive taste of carbonic acid. Some consumers find both the prickly sensation and the taste of carbonic acid to be unpleasant. It can also produce an uncomfortable bloating feeling.

Gases that are sparingly insoluble in water, such as oxygen, are not usually employed in a drinkable liquid in the same manner as more soluble gases such as carbon dioxide. Oxygen has a

solubility of 0.043 g kg^{-1} in water at 20° C and atmospheric pressure. As a result, when oxygen is added to a drinkable liquid under atmospheric conditions, or a container holding a pressurised oxygenated beverage is opened to the atmosphere, a substantial proportion of the oxygen contained in the beverage and packaging will rapidly escape from the beverage and be dispersed in the surrounding atmosphere.

Notwithstanding these difficulties, several attempts have been made to make a beverage that contains dissolved oxygen.

Japanese patent specification JP 64-27458 discloses a health drink product comprising a beverage with oxygen dissolved therein under pressure. However, since oxygen is very sparingly soluble in water and in the known health beverage nearly all of the oxygen packaged with the beverage escapes when the beverage container is opened. As a result, there is almost no effervescence on consumption.

United States patent specification US 5378480 describes a method for preparing an oxygenated beverage that is to be immediately ingested following preparation. The method involves measuring out in a container a quantity of powder that includes a foaming agent capable of trapping and temporarily holding oxygen gas, adding that powder to a predetermined quantity of liquid, evenly mixing the powder and liquid to produce a foamed beverage, and using a hand-held oxygen canister to evenly disperse oxygen throughout the beverage within the container via a dispensing tube. US 5378480 teaches that the beverage must be immediately ingested following preparation or else the oxygen content of the beverage will be rapidly lost.

Japanese patent specification JP 1168269 concerns a method of improving the flavour of a drink by generating bubbles in a drink that contains a large amount of oxygen. The drink is gasified by dispersing pressurised oxygen into a drink into which a high

concentration of oxygen has already been dissolved. The spray nozzle is operated to open the valve and release the water containing oxygen dissolved therein.

There therefore remains a need for a beverage product containing a sparingly soluble effervescence inducing gas that gives a smooth and silky mouthfeel when dispensed from a suitable dispenser that avoids at least some of the aforementioned disadvantages of the known products or at least provides the consumer with a useful alternative.

Statement of the invention

In broad terms the present invention relates to a beverage product comprising a dispenser and a beverage in which the dispenser has a container for holding the beverage and a valve which is biased to a position where it seals the container but which is openable to enable the beverage to be dispensed from the container and in which the beverage is a liquid having a sparingly soluble effervescence inducing gas dissolved therein, the beverage product being characterised in that the beverage is held under a gaseous pressure in the head space above the liquid beverage in the container that is sufficient to cause the beverage to be discharged from the dispenser as an effervescent fluid when the valve is open.

The beverage is preferably held under a gaseous pressure in the headspace of at least 2.5 atmospheres gauge at 5 to 15° C.

The sparingly soluble effervescence inducing gas is preferably selected from the group consisting of oxygen, nitrogen, nitrous oxide, hydrogen, noble gases, gaseous hydrocarbons and mixtures thereof. If desired, a further gas which is more soluble in water than those listed above and which has a partial pressure in the

headspace not exceeding 1 atmosphere absolute at 18° C, for example carbon dioxide, may also be dissolved in the beverage.

The effervescent fluid contains very small bubbles of the sparingly soluble gas and does not give the prickly sensation produced by effervescence of a more soluble gas such as carbon dioxide. The fluid provides the consumer with a smooth and silky sensation, which can enhance flavour delivery from a flavoured beverage. If the beverage is transparent, for example it is water or flavoured water, the many small bubbles of the sparingly soluble gas give the beverage a smoke-like appearance on consumption.

The beverage is preferably tea or coffee based, or water or a flavoured water.

Preferably the valve can be of a type which is known for use in pressurised dispensing containers (often known as aerosol cans). Such valves are readily available from several manufacturers. Known aerosol valves of this type have a valve member which is normally held in a sealing position to prevent egress of the contents of the pressurised container. In the sealing position the valve member is urged into contact with a sealing member, for example by a spring. The valve member is then moved to a dispensing position to allow the contents of the pressurised container to be dispensed. As the valve member is moved towards the dispensing position, the valve member and the sealing member are moved apart allowing the passage through the valve of the contents of the pressurised container under the pressure exerted by a pressurised gas within the container (propellant). The valve member may be moved away from the sealing member by a reciprocating movement or by a rocking movement. Though the above-described aerosol valves are preferred, any valve that is suitable for the purpose could be used in the present invention. Hereinafter valves of the type described above will be referred to as "aerosol valves"

The amount of liquid beverage and effervescence inducing gas inside the container is preferably such that several portions of effervescent fluid can be dispensed over a period of time by successive openings of the valve.

The dispenser preferably includes actuator means in the outlet portion of the dispenser that are operable to open the valve to release the effervescent fluid from the container. The actuator means is preferably shaped and positioned to be engaged and operated by a consumer's mouth or teeth so that the effervescent fluid can be discharged directly into the consumer's mouth. Preferably, the actuator means includes a button mounted in the outlet portion, the button being movable between a valve-closed position and a valve-open position to which it can be moved by a biting action applied to the outlet portion.

The container preferably has a dip tube that extends from the valve into the interior of the container so that the end of the dip tube is below the level of the beverage when the container is upright so that the effervescent fluid is urged to pass through the dip tube when the valve is open. The dip tube may have an aperture which communicates between the headspace above the beverage in the container and the interior of the dip tube enabling gas from the headspace to be entrained in fluid being dispensed through the dip tube when the valve is open. In the container having an aperture in the dip tube the quantity of gas expelled from the container when the valve is opened is greater than 0.5 cubic centimetres per 1 cubic centimetre of liquid beverage when measured at at atmospheric pressure and 20° C.

The present invention can also be said to be a method for producing an effervescent beverage fluid comprising placing a liquid beverage in a container, sealing the container, introducing a sparingly soluble effervescence inducing gas into the container

so that the gaseous pressure in the headspace of the container is sufficient to cause the beverage to be discharged from the dispenser as an effervescent fluid when the valve is open, and opening that valve to discharge the beverage as said effervescent fluid.

For the avoidance of doubt the word "comprising" is intended to mean including but not necessarily "consisting of" or "composed of". In other words the listed steps or options need not be exhaustive.

Except in the examples, or where otherwise explicitly indicated, all numbers in this description indicating amounts or concentrations of material ought to be understood as modified by the word "about".

Brief description of the drawings

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a cross-sectional side view of a first preferred embodiment of a beverage product of the present invention.

Figure 2 is a cross-sectional view to an enlarged scale of the valve of the beverage product shown in Figure 1.

Figure 3 is a cross-sectional side view of a second preferred embodiment of a beverage product of the present invention.

Figure 4 is a cross-sectional side view of a third preferred embodiment of a beverage product of the present invention.

Figure 5 is a cross-sectional side view of a fourth preferred embodiment of a beverage product of the present invention.

Figures 6a, 6b, 6c and 6d show internal and external views of a first preferred mouth operated actuator that can be used to dispense the beverage from the beverage product of the present invention

Figures 7a, 7b, 7c and 7d show internal and external views of a second preferred mouth operated actuator that can be used to dispense the beverage from the beverage product of the present invention

Figures 8a, 8b, 8c and 8d show internal and external views of a third preferred mouth operated actuator that can be used to dispense the beverage from the beverage product of the present invention

Figures 9a and 9b show internal views of a fourth preferred mouth operated actuator that can be used to dispense the beverage from the beverage product of the present invention

Figures 10a, 10b, 10c and 10d show internal and external views of a fifth preferred mouth operated actuator that can be used to dispense the beverage from the beverage product of the present invention

Figures 11a and 11b show internal views of a sixth preferred mouth operated actuator that can be used to dispense the beverage from the beverage product of the present invention

Figures 12a, 12b, 12c and 12d show internal and external views of a seventh preferred mouth operated actuator that can be used to dispense the beverage from the beverage product of the present invention

Figures 13a, 13b, 13c and 13d show internal and external views of an eighth preferred mouth operated actuator that can be used to dispense the beverage from the beverage product of the present invention

Figures 14a, 14b and 14c show cross-sectional views of a ninth preferred mouth operated actuator that can be used to dispense the beverage from the beverage product of the present invention

Figure 15 is a cross-sectioned view of a fifth preferred embodiment of a beverage product of the present invention that includes a widget-type device.

Figures 16a and 16b are perspective views, from above and below respectively, of the widget-type device shown in Figure 15.

Figure 17 is a cross-sectional view of a sixth preferred embodiment of the beverage product of the present invention that has a gas capsule that is held within the container underneath the splayed end of a dip tube.

Figure 18 is a graph indicating acceptable pressures for the beverage product shown in Figure 3 (see Example 1).

Figure 19 is a view of an assembly used to test the effervescence resulting from the use of the second embodiment of the beverage product shown in Figure 3 (see Example 2).

Figure 20 is a graph illustrating the variation of bubble size with varying partial pressure of oxygen in the beverage product shown in Figure 3 (see Example 2).

Detailed description of the invention

The beverage product of the present invention comprises a dispenser and a pressurised beverage.

The dispenser has a container that is suitable for holding the beverage in a pressurised state and a valve that can be opened to allow for the beverage to be discharged from the dispenser as an effervescent fluid.

The beverage contains dissolved therein a sparingly soluble effervescence inducing gas. That gas can be oxygen, nitrogen, nitrous oxide, hydrogen, a noble gas, a gaseous hydrocarbon or a mixture thereof. Oxygen is specially preferred as it is non-toxic, non-asphyxiating and safe at high temperatures. If desired, a further gas which is more soluble in water than those listed above and which has a partial pressure in the headspace not exceeding 1 atmosphere absolute at 18° C, for example carbon dioxide, may also be dissolved in the beverage.

The sparingly soluble effervescence inducing gas should be dissolved in the beverage under a gaseous pressure in the headspace that is sufficient to cause the beverage to be discharged from the dispenser as an effervescent fluid when the valve is open. The present inventors have found that that pressure is preferably at least 2.5 atmospheres gauge at 5 to 15° C otherwise the gas tends to be liberated from the without producing the desired effervescent fluid when the beverage is discharged from the dispenser.

The beverage is preferably tea or coffee based or water. It could include any suitable favouring substance or substances. The beverage can include milk, a whitener, a creamer, a flavour, a sweetener, a preservative or any number or combination thereof. The beverage could also be fruit-based, vegetable-based, yoghurt-based, soya-based, alcoholic, a beer, a smoothie or a diet

product. If desired the beverage packaging can contain an oxygen adsorbing material such as a zeolite to minimise oxidation.

It is convenient for the valve of the dispenser to be an aerosol valve as they are readily available, however one could use any valve that is suitable for the purpose.

When the valve is opened the pressurised beverage discharges from the container of the dispenser as an effervescent fluid. This fluid contains very small bubbles of the sparingly soluble gas and does not give the prickly sensation or bloated feeling sometimes produced by effervescence of a more soluble gas such as carbon dioxide. The effervescent fluid provides the consumer with a smooth and silky sensation. It can even enhance the flavour delivery from a flavoured beverage. If the beverage is transparent, for example water or flavoured water, the effervescence of the sparingly soluble gas gives the beverage a fine, smoke-like appearance on consumption.

The dispenser preferably includes actuator means that are operable to open the valve to release the liquid beverage from the container. The actuator means are preferably shaped and positioned to be engaged by a user's mouth or teeth so that the effervescent fluid will be delivered directly into the consumer's mouth. It could alternatively be adapted to be operated by the consumer's hand or finger. The actuator means can take a variety of forms but is preferably incorporated in an outlet portion of the dispenser. In a preferred embodiment of the dispenser the actuator means includes a button mounted in the outlet portion of the dispenser whichcan be moved between a valve-closed position and a valve-open position by a twisting, sucking or biting action that is applied to said outlet portion or by some other manner of manipulation by the consumer.

Various preferred embodiments of the dispenser of the beverage product of the present invention will now be described with

reference to several preferred embodiments that are depicted in the accompanying drawings.

A first preferred embodiment of the beverage product of the present invention is shown in Figure 1. The beverage product comprises a dispenser 1 and a beverage 2. The dispenser 1 has a container 3 for holding the beverage. The container 3 is capable of withstanding an internal gauge pressure of at least 2.5 atmospheres. The beverage is water-based and has dissolved therein some of a sparingly soluble effervescence inducing gas (oxygen, nitrogen, nitrous oxide, hydrogen, a gaseous hydrocarbon, one or more noble gases e.g. helium, neon and krypton, or a mixture thereof) that is contained within a headspace 4 above the beverage 2. The container 3 has a neck to which is fitted a normally closed valve 5. This is preferably a high-throughput aerosol valve. A dip tube 6 extends downwardly from the valve 5, through the headspace 4 and into the beverage 2. When the valve 5 is opened and the dispenser 1 is upright the pressurised beverage 2 will be urged up the dip tube 6 and expelled from the dispenser 1 through the valve 5.

In the first preferred embodiment the dip tube 6 is rigid however it could alternatively be made of a flexible material. When the dip tube 6 is flexible it can be advantageous to attach a weight (not shown) to the end of the tube 6 so that it remains immersed in the beverage as the dispenser is tilted and the volume of the beverage drops.

The valve 5 of the first preferred embodiment is shown schematically in greater detail in Figure 2. The valve 5 has a valve housing 7, the lower end of which is attached to the upper end of the dip tube 6 as shown in Figure 1. The upper end of the housing 7 has a gasket 8 forming a valve seating that co-operates with a movable valve member 9. That valve member 9 is constituted by a stem 10. The stem 10 has a blind bore 14 which communicates with a radial port 15 extending through the wall of the tubular

stem 10. The tubular stem 10 is biased by a spring 11 to a closed position in which the outer end of the radial port 15 engages the gasket 8 to prevent fluid flow from the valve housing 7 into the radial port 15 and the blind bore 14 of the stem 10. A further gasket 12 and an annular ring 13 enable the valve 5 to be sealed to the neck of the container 3 for example by crimping.

To dispense the beverage 2, the user tilts or depresses the stem 10 (or another element attached to the stem 10) so as to overcome the bias of the spring 11 moving the outer end of the radial port 15 out of sealing contact with the gasket 8 to allow the beverage to pass between into the radial port 15 and the blind bore 14 of the stem 10. The beverage 2 may be dispensed into another container for drinking but is preferably dispensed directly into the consumer's mouth.

A second preferred embodiment of the beverage product of the present invention is shown in Figure 3. The beverage product shown in Figure 3 is similar to that shown in Figure 1 except it does not have a dip tube 6. That means the dispenser must be inverted or at least significantly tilted before a consumer can drink from the dispenser.

In order to manufacture the first and second embodiments of the beverage product shown in Figures 1 and 3, the beverage 2 is placed in the container 3, which can then be flushed with the effervescence inducing gas. The container 3 is then sealed with the valve 5, and more of the effervescence inducing gas is added through the valve 5 until the pressure in the headspace 4 has reached its required value, which is preferably more than 2.5 atmospheres gauge. When the valve 5 is then opened for operation the pressure in the headspace 4 expels the beverage through the dip tube 6 and the valve 5 as an effervescent fluid. Because of this, unless the pressure is very high, a substantial amount of headspace should initially be present. Preferably, the headspace

4 occupies 10 to 80%, preferably 20 to 50%, of the volume of the container 2.

A third preferred embodiment of the beverage product of the present invention is shown in Figure 4. In this embodiment the dip tube 6 of the first preferred embodiment is replaced by a flexible bag 16 that has an upper neck that is sealed to the housing 7 of the valve 5. The bag 16 holds the beverage 2 under pressure from the sparingly soluble gas or gas mixture in the headspace 4 and also a second gas space 17. The headspace 4 can be considerably smaller than the headspace 4 of the beverage products shown in Figures 1 and 3. The second gas space 17 exists between the bag 16 and the container 3. This second gas space 17 is filled with pressurised gas through a second valve (not shown) passing through the wall or the base of the container 3. The second gas may be the same gas (or a gaseous mixture) as that which fills in the headspace 4 or may be different. This construction allows the beverage 2 to be dispensed regardless of the orientation of the container 3.

In order to manufacture the third embodiment shown in Figure 4, the beverage 2 is placed in the flexible bag 14 and the valve 5 sealed to the neck of the container 3. The effervescence inducing gas is then introduced into the headspace 4 through the valve 5. The headspace 4 may be very small, preferably less than 20% of the capacity of the bag 14. The space 17 between the bag 16 and the container 3 is pressurised after the valve 5 has been sealed to the container. The expansion of gas in the space 17 provides the driving force to expel the beverage 2 from the container 3 of the dispenser 1 through the valve 5 and into another container for drinking or directly into the consumer's mouth.

In each of the aforementioned embodiments, the pressure in the headspace 4 exceeds 2.5 atmospheres gauge, which causes the sparingly soluble gas (or mixture of sparingly soluble gases) to effervesce on discharge into the consumer's mouth or into water

under test conditions. This effect is demonstrated in Examples 1 and 2.

A fourth preferred embodiment of the beverage product of the present invention is shown in Figure 5. It is very similar to the first embodiment but differs in that the container has a curvaceous shape to more ergonomically fit the hand of a consumer, and more significantly in that an aperture 18 is provided in the wall of the dip tube 6 or the valve housing 7 that is preferably close to where the dip tube 6 is attached to the valve 5. While in this embodiment the aperture 18 takes the form of a single aperture, one could alternatively have multiple apertures or use a mesh or some other form of porous material.

In use, with the dispenser 1 in the upright position, a consumer opens the valve 5 by applying downward or sideways force on valve member 9. If a non-aerosol-type valve were used the consumer might apply a torque to open it instead. On opening of the valve 5, gas is entrained through the aperture 18 in dip tube 6 into the stream of pressurised beverage 2 that flows through the dip tube 6 resulting in the expulsion of a two-phase mixture of liquid and gas that constitutes an effervescent fluid. When force is removed from the valve member 9 the valve 5 closes under the action of the spring 11, terminating the flow of the effervescent fluid from the container 3. The valve 5 can be operated in this manner as often as desired until the supply of beverage and effervescence inducing gas has been exhausted. Unlike the first preferred embodiment, the fourth preferred embodiment functions in any orientation, but it tends to work better when held upright.

An actuator is preferably attached to and forms part of the dispenser 1 of the beverage product of the present invention and includes means for moving the valve 5 from its closed position to its open position. This actuation is preferably reversible and more especially operable using the consumer's mouth and/or teeth.

Figures 6a through to 14c depict a variety of mouth operated actuators that will now be described in detail.

A first preferred embodiment of a mouth operated actuator 20 is shown in Figures 6a, 6b, 6c and 6d. Referring to Figure 6a, which is a cross-sectional view, the actuator 20 is secured to the neck of the container 3 and/or the valve 5 of the dispenser 1 and covers the stem 10 of the aerosol valve 5. The actuator 20 has a housing 21 and a stem extension 24 that are pivotally attached to the dispenser at pivot point 22.

The upper part of the housing 21 forms a tapering nozzle section 23 that has a central passage constituted by the stem extension 24 that leads from the valve stem 10 to a nozzle outlet 25 at the upper end of the nozzle. The housing 21 and the nozzle section 23 are shaped so that when it is inserted into the mouth of a consumer, the consumer's lips engage the nozzle to provide a seal.

The actuator has a button 26 that is attached to the stem extension 24. The button 26 protrudes through the wall of the housing 21 through a circular button aperture 27. The button 26 is movable between a normal inoperative position shown in Figure 6a and a depressed operative position shown in Figure 6b. In the position of the button illustrated in Figure 6a, the valve is closed so no effervescent fluid can escape from the container 3. In the position of the button illustrated in Figure 6b, the button 26 has displaced the valve stem 10, pressing it down vertically by means of the stem extension 24 rotating about the pivot point 22 to open the valve 5. Thus the valve stem 10 is linearly displaceable in this embodiment. The area of the nozzle opposite to the button 26 is formed with a textured surface 28a, e.g. by the integral moulding of recesses or projections or by the application of a piece of non-slip material. A similar textured surface may be provided on the surface 28b of the button 26.

Figures 6c and 6d show front and rear exterior views of the mouth operated actuator shown in Figures 6a and 6b.

In use a consumer grasps the outer case of the dispenser 1 and inserts the nozzle section 23 of the mouth operated actuator into his or her mouth. To open the valve and thus dispense the effervescent fluid directly into the mouth, the consumer applies a biting action on the textured surface 28b on the button 26 and the textured area 28a on the area opposite the button 26. That action depresses the button 26 in the direction of movement illustrated by the solid arrow in Figures 6a and 6b. The textured surfaces 28a and 28b prevent the consumer's teeth from slipping. The button 26 reverts to its normal extended position (and the valve to its closed position) when the compressive force applied across the nozzle as a result of the biting action is removed.

A second preferred embodiment of a mouth operated actuator is shown in Figures 7a, 7b, 7c and 7d. In this embodiment the valve is tilt operable. The button 26 of the actuator 20 shown in Figures 7a and 7b is not attached to the stem extension 24 but is attached by pivot point 29 to the housing 21. When the button 26 is engaged by the consumer's teeth it pivots about the pivot point 29 and this displaces the valve stem 10, thereby opening the valve so as to dispense the effervescent fluid directly into the consumer's mouth. The stem extension 24 may be made of a flexible material, so that it can flex and thereby maintain a good seal with the valve stem 10 during operation.

The external appearance of the second preferred embodiment of the mouth operated actuator of Figures 7a and 7b is shown in Figures 7c and 7d, as front and rear views respectively.

A third preferred embodiment of a mouth operated actuator is shown in Figures 8a, 8b, 8c and 8d. In this embodiment the actuator 20 has two depressible buttons 26 on opposite sides of the housing 21, each button being pivotally connected to the housing 21 at a

pivot point 29 like the button 26 of the second preferred embodiment of the actuator shown in Figures 7a and 7b. When the two buttons are depressed (as seen in Figure 7b), they pivot about hinge points 29 and engage a downwardly diverging frusto-conical shape at the end of the stem extension 10, so as to cause the stem 10 to move towards the container opening the valve 5, thereby dispensing the effervescent fluid. Thus, the stem 10 is linearly displaceable in this embodiment.

Figures 8c and 8d show, in front and rear views respectively, the external appearance of the nozzle of the dispenser of Figures 8a and 8b.

A fourth preferred embodiment of a mouth operated actuator is shown in Figures 9a and 9b. In this embodiment the button 26 is mounted on the stem extension 24 and when it is depressed (as seen in Figure 9) it tilts the stem extension 24 and opens the tilt-operated valve thereby dispensing the effervescent fluid. The external appearance is the same as that of the first preferred embodiment of the actuator shown in Figures 6c and 6d.

A fifth preferred embodiment of a mouth operated actuator is shown in Figures 10a, 10b, 10c and 10d. In this embodiment the button 26 can be lower down on the housing 21, and when depressed, the stem extension 24 pivots about a pivot point 30 near the top of the housing 21 causing the tilt-operated valve to open.

Figures 10c and 10d show the external appearance of the actuator, in front and rear views respectively.

Alternatively, the top of the stem extension 24 can be firmly fixed to the top of the housing 21, and the stem extension 24 and the housing 21 can be made of a flexible material. In such a variation, the button 26 attached to the stem extension 24 is typically higher up, and when the button is depressed, it causes the stem extension 24 to flex and at the same time the valve stem

10 to tilt, thereby opening the valve 5. The flexibility of the stem extension 24 allows a good seal to be maintained between the valve stem 10 and the stem extension 24 during operation.

A sixth preferred embodiment of a mouth operated actuator is shown in Figures 11a and 11b. In this embodiment the actuator has a flexible stem extension 24. Depressing button 26 causes the stem extension 24 to flex, thereby tilting the valve stem 10 and opening the valve. The button 26 is pivotally attached to the housing 21 at pivot point 29.

The external appearance of the sixth preferred embodiment of actuator is the same as that of the second preferred embodiment of actuator as shown in Figures 7c and 7d.

A seventh preferred embodiment of a mouth operated actuator is shown in Figures 12a, 12b, 12c and 12d. In this embodiment the consumer grips the housing 21 with his or her teeth and applies a downward force in the direction of the solid arrows shown in Figures 12a and 12b. The housing 21 has a concertina formation 31 that allows the upper part of the housing 21 to be moved towards the container. The downward force applied to the housing 21 is transferred to the valve stem 10 so as to open the valve, thereby dispensing the effervescent fluid.

Figures 12c and 12d illustrate the external appearance of the seventh preferred embodiment of the actuator in front and rear views respectively and show the aforementioned concertina formation 31 of the housing 21.

An eighth preferred embodiment of a mouth operated actuator is shown in Figures 13a, 13b, 13c and 13d. In this embodiment the nozzle section 23 is a separate part of the actuator 20 that is threaded onto the housing 21 to provide for relative rotation of the nozzle section 23 and the remainder of the dispenser 1. In use the consumer grips the nozzle section 23 between his or her

teeth and then grasps the housing 21 (where it surrounds the container) so as to rotate the container 3 relative to the nozzle section 23. This rotation (indicated by the solid arrows in Figure 13b) moves the valve stem 10 to open the valve and thereby dispense the effervescent fluid directly into the consumer's mouth.

Figures 13c and 13d illustrate the external appearance of the eighth preferred embodiment of actuator, in front and rear views respectively.

A ninth preferred embodiment of a mouth operated actuator is shown in Figures 14a, 14b and 14c. In this embodiment one side of the actuator has a concave recess 32 that is designed to contact the lower lip of a consumer. But more importantly the actuator 20 has a slidable plug 33 that is formed around the stem extension 24 and prevents the valve from being opened when the dispenser is inverted.

The actuator is similar to that of the sixth preferred embodiment shown in Figures 11a and 11b in that the stem extension 24 is flexible and the valve 5 is opened by applying pressure on the button 26, which causes the stem extension 24 to flex and thereby tilt the valve stem 10. The slidable plug 33 has no effect when the dispenser is used in a substantially upright position (see Figures 14a and 14b). However, when the dispenser is inverted (see Figure 14c) the slidable plug 33 slides down the stem extension 24 towards the nozzle outlet 25 and a wedge 34 that forms part of the plug 33 provides sufficient resistance to prevent the consumer from flexing the stem extension 24 when he or she tries to depress the button 26. A stopper 35 is provided on the exterior surface of the stem extension 24 adjacent to the nozzle 23 to restrict the movement of the plug 33 when the dispenser is inverted.

In all embodiments of the mouth operated actuator, the delivery of liquid is directly into the consumer's mouth, under the control of the consumer's bite. The consumer's fingers do not need to touch any part of the nozzle, thereby reducing the chance of the nozzle becoming contaminated. If desired a protective and replaceable cap (not shown) can cover the nozzle.

If desired the beverage product of the present invention can include a widget that contains the sparingly soluble gas or gas mixture and/or a flavour concentrate that is released into the container when the dispenser is being used.

"Widget" has become a term of art, at least in the brewing industry, to describe a device that releases pressurised gas into a can of beer when the can is opened thereby producing a creamy head typical of draught beer. The first widget or in-can-draught system is described in United Kingdom patent specification GB 2183592 A (Arthur Guinness Son and Company (Dublin) Limited). Various other versions have since become commercially available.

A tenth preferred embodiment of the beverage product of the present invention includes a widget-type device, herein just called a "widget". The embodiment is shown in Figure 15 and the widget is shown in more detail in Figures 16a and 16b.

The tenth embodiment of the beverage product shown in Figure 15 is much like the first embodiment shown in Figure 1 in that it comprises a dispenser 1 for containing a beverage 2 in a container 3. The dispenser has a valve 5 (not shown) with a dip tube 6. In this embodiment a toroidal widget 36 is suspended above the base of the container 3 around the inlet of the dip tube 6. The widget is shown in a perspective view from above in Figure 16a and in a perspective view from below in 16b. Perforations 37 are formed in the downward facing surface of the widget 36, as seen in Figure 16b. Naturally the perforations could take other forms; a single perforation could be sufficient or the widget could include a mesh

or some other porous material. In the case where the widget 36 shown is filled with just gas the perforations 37 can face in any orientation.

The widget 36 contains the sparingly soluble effervescence inducing gas or gas mixture under pressure and remains there while the contents of the container 3 is pressurised. In use when a consumer opens the valve for the first time, the pressure within the container drops as some of the pressurised gas within the headspace is dispensed. The sparingly soluble gas or gas mixture escapes from the widget 36 through the perforations 37. With the sparingly soluble gas or gas mixture free within the container the effervescent fluid will be created as previously described, which can be poured into a drinking vessel or directed straight into the consumer's mouth.

An eleventh preferred embodiment of the beverage product of the present invention that also includes a widget is shown in a cross-section in Figure 17. In this embodiment the widget 36 is substantially spherical in shape and includes at least one perforation 37 that is located to discharge its contents upwards into a dip tube 6. The dip tube 6 has a splayed or flared inlet 38 to catch the discharging contents of the widget 36. The dip tube 6 optionally has an aperture 16 much like the fourth preferred embodiment of the beverage product.

If desired the widget, such as the widget shown in Figure 16, a can contain a concentrated flavour together with the sparingly soluble gas or gas mixture. In this case the flavour is expelled from the widget close to the end of the dip tube and so is taken together with the beverage. This arrangement can be used to keep labile flavours separate from the gas in the headspace above the beverage.

EXAMPLES

The beverage product of the present invention will now be described with reference to the following examples.

EXAMPLE 1

Determination of filling pressure for effective effervescence

The following experiment was conducted to determine the filling pressure that is required to produce the desired effervescence.

Gas samples containing oxygen and nitrogen in various proportions (molar fraction of O_2 of 0.0, 0.25, 0.5, 0.75, 1.0) were prepared and used to fill a beverage dispenser as shown in Figure 3 using a variety of filling pressures. The dispensers were tested to see whether they produced a fine smoke-like effervescent fluid.

The samples were prepared and tested in duplicate to check reproducibility. All temperatures given were measured using a thermocouple probe.

For each sample, the following protocol was observed:

(1) 300 ml of tap water at 10 $\pm$ 0.5° C was poured into a strong polyethylene terephthalate ("PET") bottle of 28 g mass and 520 ml brimful capacity. The bottle was then left to equilibrate in a temperature-controlled bath also at 10 $\pm$ 0.5° C.

(2) The proportion of oxygen gas in the oxygen-nitrogen mixture had been decided on in advance, and whichever gas was to be at a higher partial pressure in the mixture is called "gas 1". The other gas will be referred to as "gas 2".

(3) The headspace above the water in the bottle was flushed with gas 1 for 5 to 10 seconds, and then the aerosol valve was placed quickly over the neck of the bottle, thus sealing the bottle from any loss of gas 1 or influx of air. The aerosol valve was then held firmly in place by means of a screw cap with a small hole cut in the centre in order to allow the stem of the valve to be accessible.

(4) More of gas 1 was then added from the regulated supply of gas 1 through the stem of the aerosol valve until a pressure "p1" was reached. The bottle was then shaken to ensure that the gas inside was at the same temperature as the liquid, and the bottle was topped up to the pressure p1 with more of gas 1. This was necessary because the temperature of the gas when first injected into the bottle is somewhat higher than 10° C.

(5) Gas 2 was then added through the stem of the valve from a regulated supply of gas 2 until a pressure "p2" was reached. Again the bottle was shaken, and then topped up with more of gas 2 to reach the pressure p2 again. Both p1 and p2 are measured in atmospheres gauge from the pressure gauge on the regulated supplies of the two gases.

(6) The sealed bottle was then placed in a temperature controlled bath at 10 $\pm$ 0.5° C for 5 minutes to equilibrate, the sample being shaken every 30 seconds to ensure good contact between the gas mixture and the water in the bottle.

(7) The bottle was then discharged under water that was at a temperature of 21 $\pm$ 1° C. The stream of discharged fluid was observed as it left the bottle against a black plastic sheet, and it was noted whether or not there was a visible, fine, smoke-like effervescence.

The results of this experiment are summarised in Figure 18 as a plot of the molar fraction of oxygen present in the mixture (horizontal axis) against the gauge pressure p2 (vertical axis).

Each error bar in Figure 18 runs from a lower value of p2, which is the highest pressure at which the effervescence is definitely not seen, to a higher value of p2, which is the lowest pressure p2 at which effervescence is definitely seen. The true critical pressure thus lies somewhere on the error bar. If there is a pressure at which there is some doubt as to whether effervescence can be seen or not, this is marked as an "x" on the error bar. These "x" marks thus represent the best estimate of the position of the critical filling pressure.

The graph has two results drawn with a lighter weight of line and marked 40 and 41. These results are shown slightly displaced in the horizontal direction, for the sake of clarity. Thus the true molar fraction of oxygen in the mixture for result 40 is 0.0, and for result 41 it is 1.0. The results labelled 40 and 41 are for a tilt operated aerosol type valve, while all the other results are for a push-down operated aerosol type valve. These results show that there is no significant difference between the types of valves used.

The results show that fine smoke-like effervescence is produced from a beverage that has an initial pressure in the headspace of 2.5 atmospheres or more, for all mixtures of oxygen and nitrogen.

EXAMPLE 2

Effervescence obtained using gas mixtures

The following experiments were conducted to determine whether the desired effervescence is obtained using a gas mixture that contains a gas that is sparingly soluble in water as well as a gas that is soluble in water.

Twelve experiments were conduced in accordance with the following protocol. The experimental set-up is shown in Figure 19 and involves using the second preferred embodiment of the beverage product shown in Figure 3. All temperatures given were measured using a thermocouple probe.

(1) 300 ml of tap water at 10 ± 0.5° C was poured into a strong polyethylene terephthalate ("PET") container (labelled 3 in Figure 19) of 28 g mass and 520 ml brimful capacity. The container 3 was then left to equilibrate in a temperature-controlled bath also at 10 ± 0.5° C.

(2) Twelve experiments were performed, referred to in the following by letters "A" to "L" inclusive. These experiments differed in the way gas was added to the container 3. In all experiments the valve 5 of the dispenser 1 shown in Figure 19 was secured to the container 3 by means of a screw cap. The screw cap had a hole through which the valve stem 10 could extend but gave a gas-tight seal.

In Experiment A oxygen was added through the valve stem 10 until the pressure inside the headspace 4 was 4 atmospheres gauge. The container 3 was shaken, and then topped up with oxygen in the same way until the pressure inside was once more 4 atmospheres gauge.

In Experiment B the headspace 4 of the container 3 was flushed with carbon dioxide from a regulated supply of the gas, for 5 seconds, to clear the headspace 4 of air. The container 3 was then sealed and CO_2 was added at 4 atmospheres from the regulated supply through the valve stem 10. While the gas was added, the container 3 was constantly shaken for 20 seconds, so that the carbon dioxide was close to equilibrium with the water 40.

In Experiment C the procedure of Experiment A was followed except before the container 3 was sealed the headspace 4 was flushed with oxygen for 5 seconds to remove the air from the headspace 5.

In Experiments D and J the container 3 was flushed with oxygen and sealed as in Experiment C. Oxygen gas was then added through the valve stem 10 up to a pressure of 3 atmospheres gauge in Experiment D and up to 3.5 atmospheres gauge in Experiment J. The container 3 was then shaken and topped up to 3 atmospheres gauge in Experiment D and 3.5 atmospheres gauge in Experiment J with oxygen. In both cases carbon dioxide was then added through the valve stem 10 with continuous shaking for 20 seconds up to a final pressure of 4 atmospheres gauge.

In Experiment E the headspace was flushed for 20 seconds with CO_2, while the container 3 was shaken, so that the CO_2 was close to equilibrium with the beverage 2 (i.e. water). The container 3 was then sealed and oxygen added through the valve stem 10 to a pressure of 4 atmospheres gauge. The container 3 was shaken, and topped up to 4 atmospheres gauge with oxygen.

In Experiments F, H and I the container 3 was flushed for 5 seconds with CO_2 then sealed. Carbon dioxide was then added through the valve stem 10, with shaking, for 20 seconds.

The final pressure of CO_2 was chosen to be 1, 2 and 3 atmospheres gauge for the Experiments F, H and I respectively. The containers were then topped up with oxygen to 4 atmospheres gauge in all cases, shaken and topped up to 4 atmospheres gauge again with oxygen.

In Experiments G and K (which are identical) the container 3 was flushed with CO_2 for 5 seconds to expel any air present, but was not shaken. The container 3 was then sealed and then oxygen was added through the valve stem 10 up to a pressure of 4 atmospheres gauge. The container 3 was then shaken, and topped up with oxygen to 4 atmospheres gauge.

In Experiment L the procedure of Experiment C was followed except nitrogen was used in place of oxygen at all points.

(3) At this stage of the procedure, the containers were all filled to 4 atmospheres gauge pressure, but with different mixtures of gases.

(4) In each experiment, the container 3 was allowed to equilibrate in a temperature-controlled bath at 18 $\pm$ 0.5° C, for 5 minutes, with shaking every 30 seconds (as in Experiment 1).

(5) In each case the container 3 was inverted, and a small fraction of its contents was discharged through a first flexible rubber tube 45, which made a good seal with the valve stem 10. The rubber tube 45 was connected to a glass pipe 46, which was fixed horizontally. Most of the length of the glass pipe consisted of a flat-sided pipe of height 9 mm (vertically), width 5 mm and length 15 cm. The other end of the glass pipe was connected to a second flexible rubber tube 47, which emptied into a beaker 48. The function of the flat-sided pipe was to enable the liquid discharged from the container 3 to be clearly seen and imaged.

Whilst the liquid was being discharged, a video camera was used to record the appearance of the discharged fluid a distance 15 cm from valve 3. This viewing region is labelled 49 in Figure 19. A grid with lines separated by 1 mm was placed behind the glass pipe to allow distances to be measured accurately from the video images.

(6) After a short discharge through the valve, effervescence was observed in the viewing region 49 of the glass pipe 46 using the video camera. This consisted of bubbles that rose in the glass pipe 46. When they reached the top of the glass pipe, the bubbles coalesced into larger bubbles. However, while they were rising in the now stationary fluid, their rise velocities could be measured by counting the number of video frames required for the bubbles to rise 1 mm. These velocities were converted into bubble sizes using Stokes' law for the rising of a sphere in a liquid of known density and viscosity (in our case, water at 18° C).

The results of these twelve experiments are summarised in Table 1 below. The table refers to "Single" and Multiple" rise times. The "single" rise time is the rise velocity of individually imaged bubbles. Whereas the "Multiple" rise time is the rise velocity of the surface of the cloud of effervescence.

TABLE 1

Results of Experiment 2

Expt	Partial pressure of oxygen	Type of rise Velocity measured	No. of readings taken	Bubble diameter
A	4.2	Single	9	48 ± 17
A	4.2	Multiple	6	39 ± 3
B	0.0	Single	9	148 ± 30
C	5.0	Single	14	49 ± 10
C	5.0	Multiple	3	55 ± 12
D	4.0	Single	33	80 ± 8
D	4.0	Multiple	8	75 ± 5
E	4.0	Single	25	61 ± 8
E	4.0	Multiple	11	61 ± 7
F	3.0	Single	37	101 ± 13
F	3.0	Multiple	7	88 ± 7
G	4.5	Single	29	51 ± 11
G	4.5	Multiple	9	48 ± 5
H	2.0	Single	28	123 ± 18
I	1.0	Single	12	181 ± 31
J	4.5	Single	52	72 ± 8
J	4.5	Multiple	11	66 ± 5
K	4.5	Single	45	54 ± 11
K	4.5	Multiple	10	49 ± 5
L	0.0	Single	11	31 ± 2
L	0.0	Multiple	12	28 ± 3

The results for the mixtures of oxygen and carbon dioxide (that is to say, for experiments B, C, D, E, F, G, H, J, and K) are plotted giving the graph shown in Figure 20. In Figure 20, the results from "Single" bubble rise times are plotted as filled circles, and the results from "Multiple" bubble rise times are plotted as open circles.

It is clear from these results that the bubble size of the effervescence increases from the value for pure oxygen if a large fraction of carbon dioxide is present in the gas mixture.

Experiments A and L show that fine effervescence (like that produced by pure oxygen) is also produced for another sparingly soluble gas (nitrogen), and also a mixture of nitrogen and oxygen.

Experiments B to K inclusive show that if the partial pressure of the soluble gas (carbon dioxide) does not exceed 1 atmosphere absolute (that is to say, if the partial pressure of the sparingly soluble gas (oxygen in this case) is greater than or equal to the total absolute pressure above the beverage, minus one atmosphere), then the effervescence size does not differ significantly from the value for pure oxygen.

In other words, the fine smoke-like effervescence produced by mixtures of nearly insoluble gases that gives a smooth (as opposed to prickly) sensation to the consumed beverage, is preserved in the presence of admixtures of a soluble gas. That is provided that the partial pressure (absolute) of the soluble gas above the beverage in the container does not exceed atmospheric pressure. That is to say, provided the soluble gas is not overly supersaturated at the serving pressure of 1 atmosphere absolute pressure.

CLAIMS

1. A beverage product comprising a dispenser and a beverage in which the dispenser has a container for holding the beverage and a valve which is biased to a position where it seals the container but which is openable to enable the beverage to be dispensed from the containerand in which the beverage is a liquid having a sparingly soluble effervescence inducing gas dissolved therein,the beverage product being characterised in that the beverage is held under a gaseous pressure in the head space above the liquid beverage in the container that is sufficient to cause the beverage to be discharged from the dispenser as an effervescent fluid when the valve is open.

2. A beverage product according to claim 1 wherein the beverage is held under a gaseous pressure in the headspace of at least 2.5 atmospheres gauge at 5 to 15° C.

3. A beverage product according to claim 1 or 2, wherein the sparingly soluble effervescence inducing gas is selected from the group consisting of oxygen, nitrogen, nitrous oxide, hydrogen, noble gases, gaseous hydrocarbons and mixtures thereof.

4. A beverage product according to claim 3, wherein the sparingly soluble effervescence inducing gas is oxygen.

5. A beverage product according to any preceding claim, wherein the beverage has dissolved therein a further gas which is more soluble in water than said sparingly soluble effervescence inducing gas and which has a partial pressure in the headspace not exceeding 1 atmosphere absolute at 18° C.

6. A beverage product according to claim 5, wherein the further gas is carbon dioxide.

7. A beverage product according to claim 1 wherein the amount of liquid beverage and effervescence inducing gas inside the container is such that several portions of effervescent fluid can be dispensed over a period of time by successive openings of the valve.

8. A beverage product according to any preceding claim wherein the valve is an aerosol valve.

9. A beverage product according to any preceding claim, wherein the beverage is water or a tea or coffee based beverage.

10. A beverage product according to any preceding claim, wherein the dispenser includes actuator means in the outlet portion of the dispenser which are operable to open the valve to release the effervescent fluid from the container, the actuator means being shaped and positioned for engagement by a user's mouth or teeth to cause or enable release of liquid directly into the user's mouth.

11. A beverage product according to claim 10, wherein the actuator means includes a button mounted in the outlet portion, the button being movable between a valve-closed position and a valve-open position to which it can be moved by a biting action applied to the outlet portion.

12. A beverage product according to any preceding claim, wherein the container has a dip tube that is attached to the valve inside the container and extends into the interior of the container so that the end of the dip tube is below the level of the beverage when the container is upright so that the effervescent fluid is urged to pass through the dip tube when the valve is open by the pressure of the gas in the headspace.

13. A beverage product according to claims 12, wherein the dip tube has an aperture which communicates between the headspace above the beverage in the container and the interior of the dip tube enabling gas from the headspace to be entrained in fluid being dispensed through the dip tube when the valve is open..

14. A beverage product according to claim 13, wherein the quantity of gas expelled from the container when the valve is opened is greater than 0.5 cubic centimetres per 1 cubic centimetre of liquid beverage when measured at atmospheric pressure and 20° C.

15. A beverage product according to claim 1, wherein the headspace within the container comprises between 10% and 80% of the volume of the container.

16. A beverage product according to claim 1 that includes means for preventing opening of the valve when the dispenser is inverted.

17. A beverage product according to claim 1 wherein the sparingly soluble effervescence inducing gas is contained in a widget that releases its contents into the container when the valve is opened.

18. A beverage product according to claim 16 wherein the widget contains a concentrated flavour that is released into the container when the valve is opened.

19. A method for producing an effervescent beverage fluid comprising placing a liquid beverage in a container, sealing the container, introducing a sparingly soluble effervescence inducing gas into the container so that the gaseous pressure in the headspace of the container is sufficient to cause the beverage to be discharged from the dispenser as an effervescent

fluid when the valve is open, and opening that valve to discharge the beverage as said effervescent fluid.

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Fig.1.

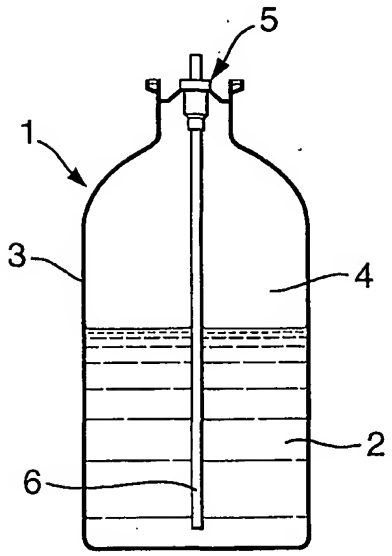


Fig.3.

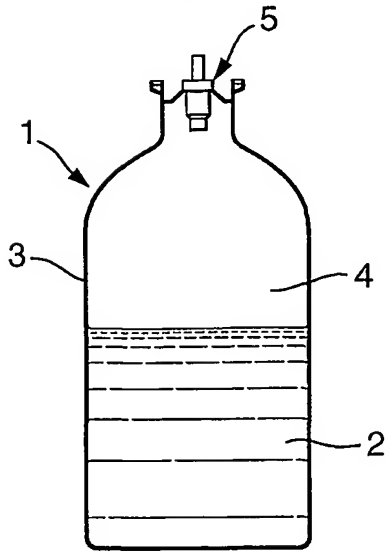


Fig.2.

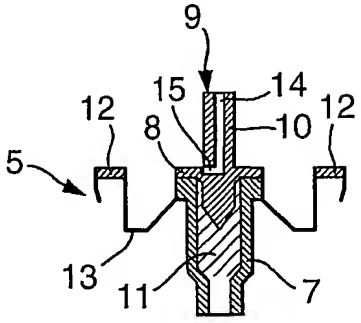


Fig.4.

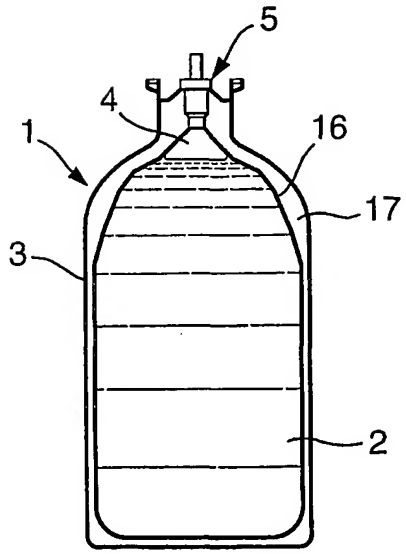


Fig.5.

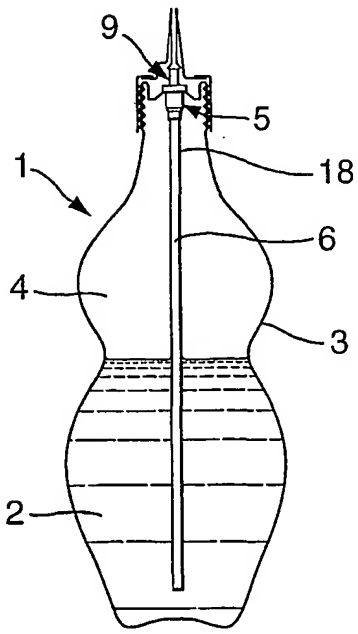


Fig.6a.

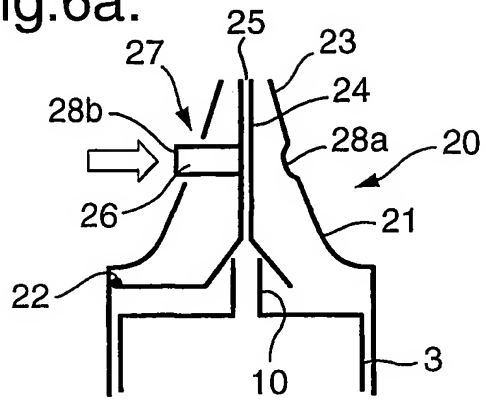


Fig.6b.

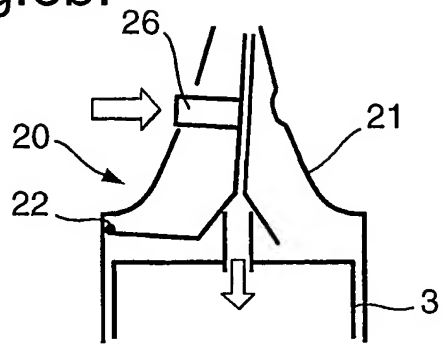


Fig.6c.

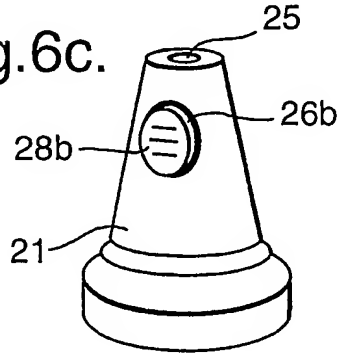


Fig.6d.

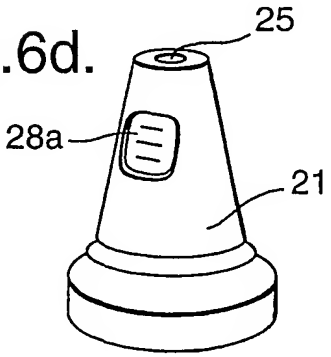


Fig.7a.

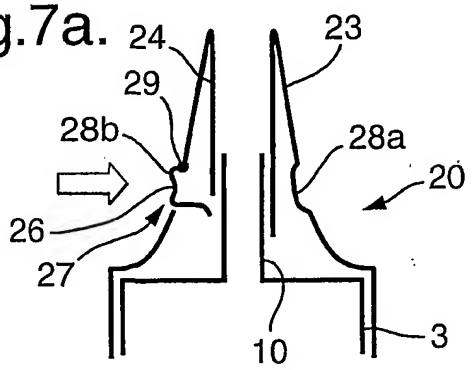


Fig.7b.

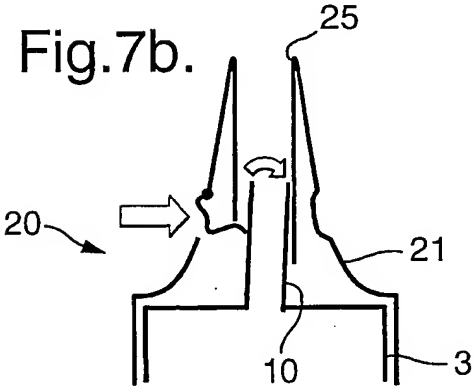


Fig.7c.

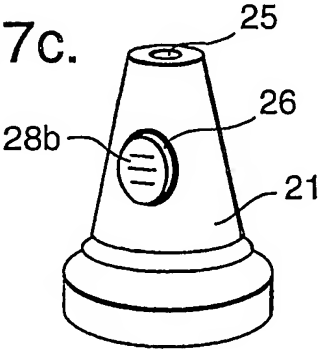


Fig.7d.

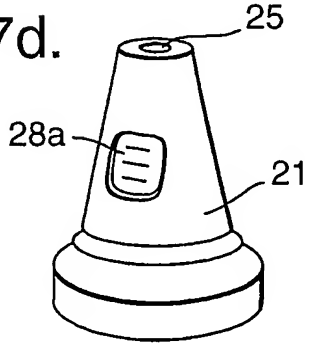


Fig.8a.

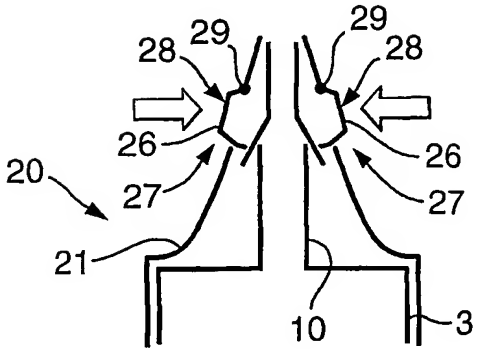


Fig.8b.

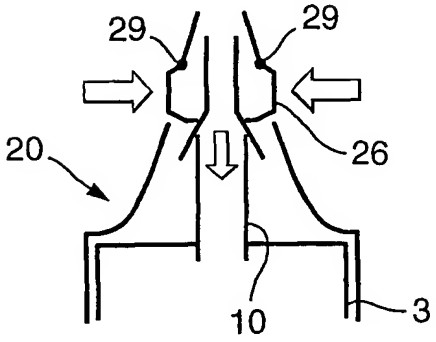


Fig.8c.

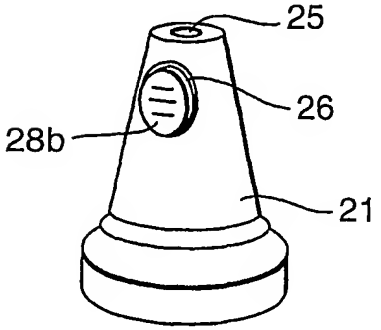
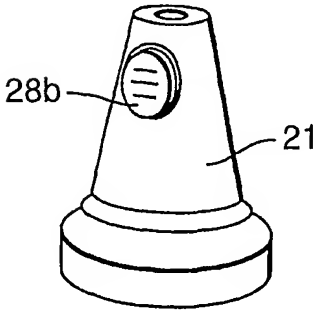


Fig.8d.



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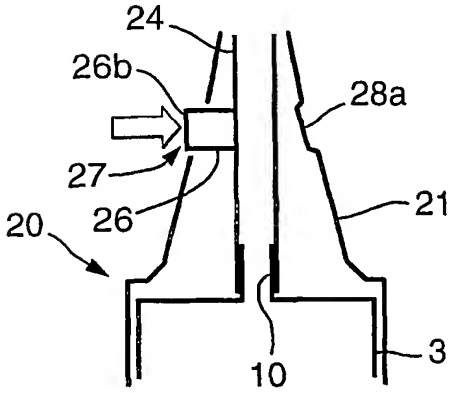


Fig.9b.

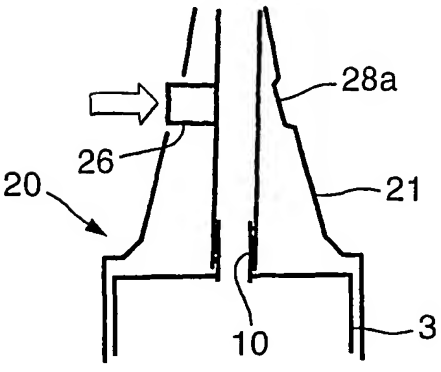


Fig.10a.

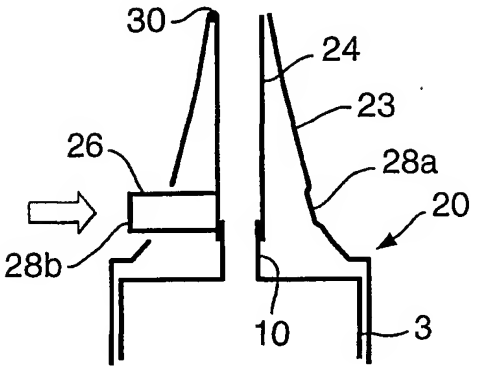


Fig.10b.

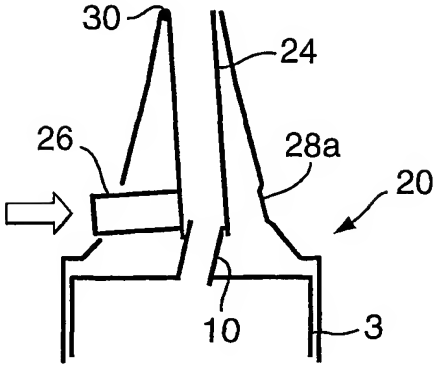


Fig.10c.

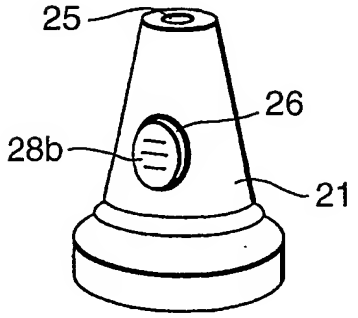


Fig.10d.

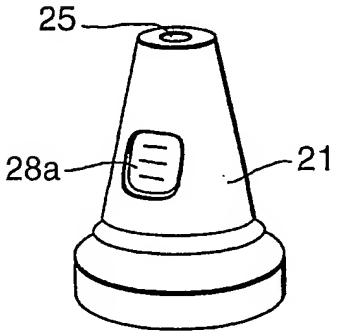


Fig.11a.

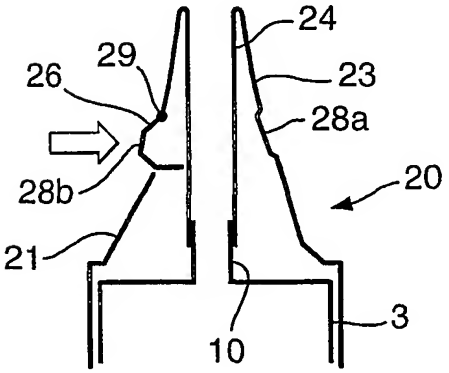


Fig.11b.

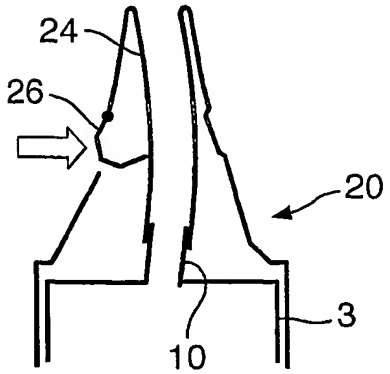


Fig.12a.

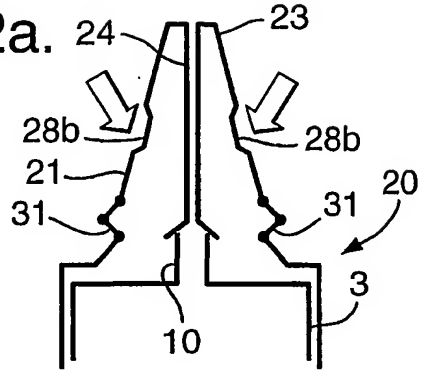


Fig.12b.

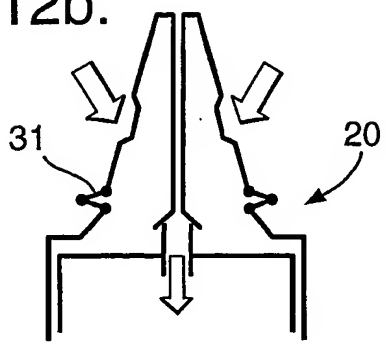


Fig.12c.

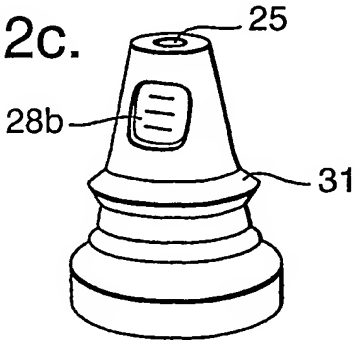


Fig.12d.

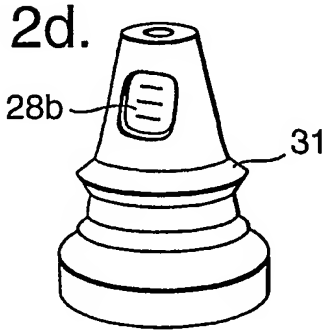


Fig.13a.

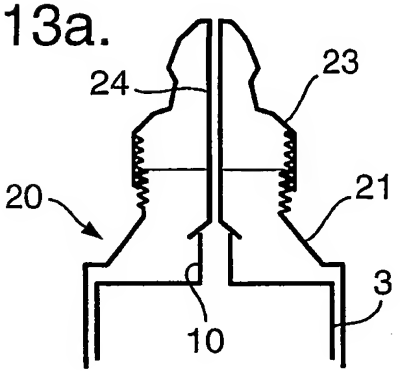


Fig.13b.

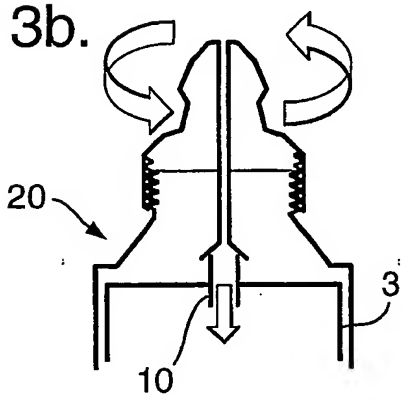


Fig.13c.

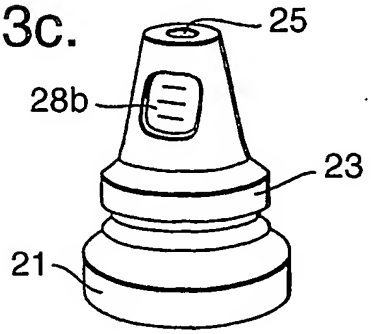


Fig.13d.

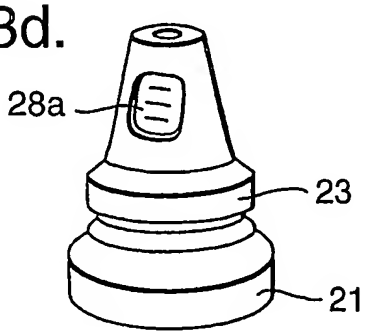


Fig.14a.

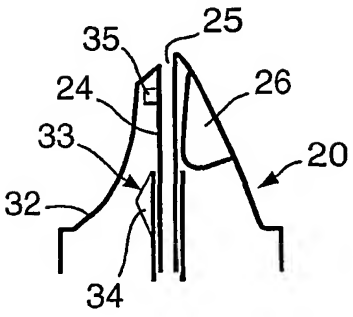


Fig.14b.

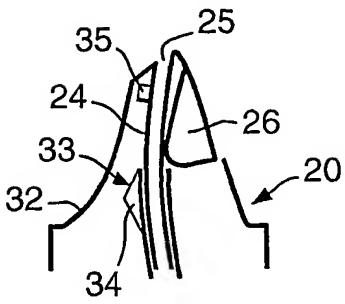


Fig.14c.

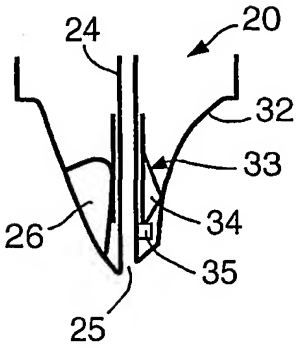


Fig.15.

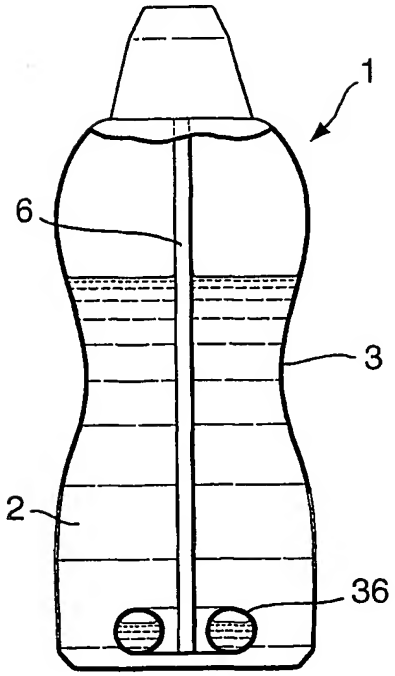


Fig.16a.

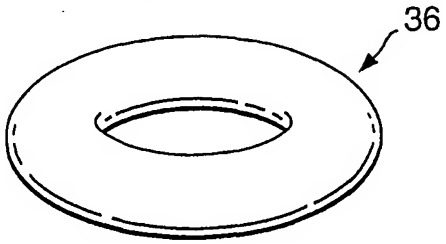


Fig.16b.

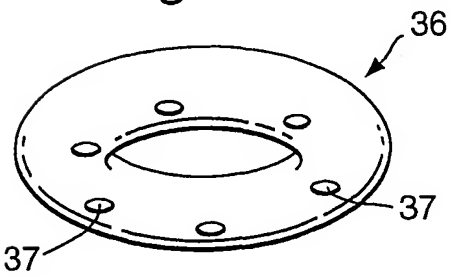


Fig.17.

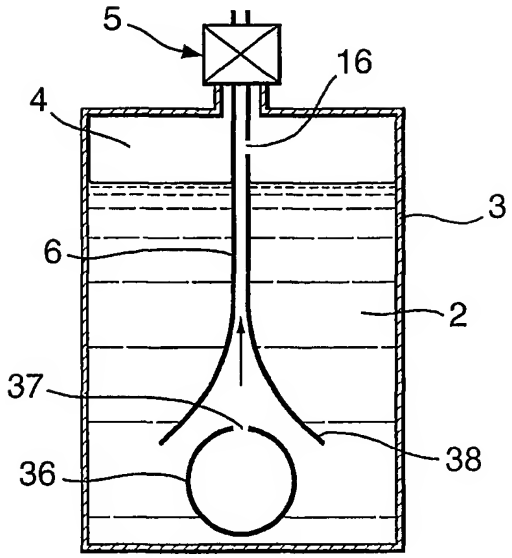

5
16
4
3
6
2
37
38
36

Fig.18.

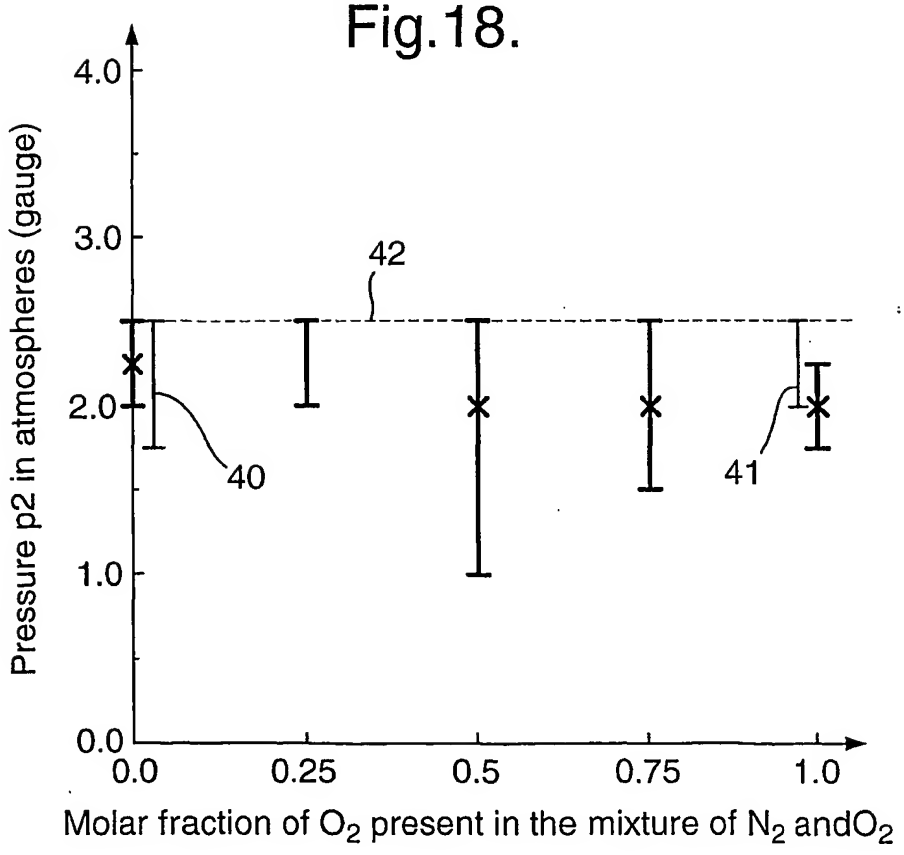

4.0
3.0
2.0
1.0
0.0
Pressure p2 in atmospheres (gauge)
42
40
41
0.0
0.25
0.5
0.75
1.0
Molar fraction of O_2 present in the mixture of N_2 andO_2

Fig.19.

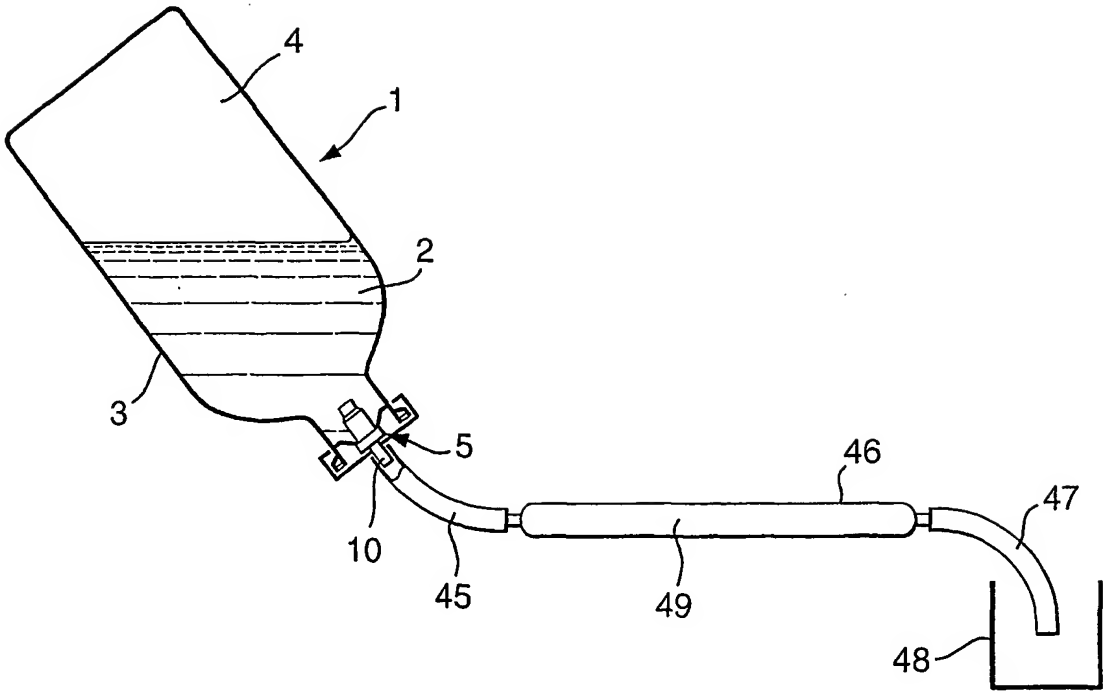
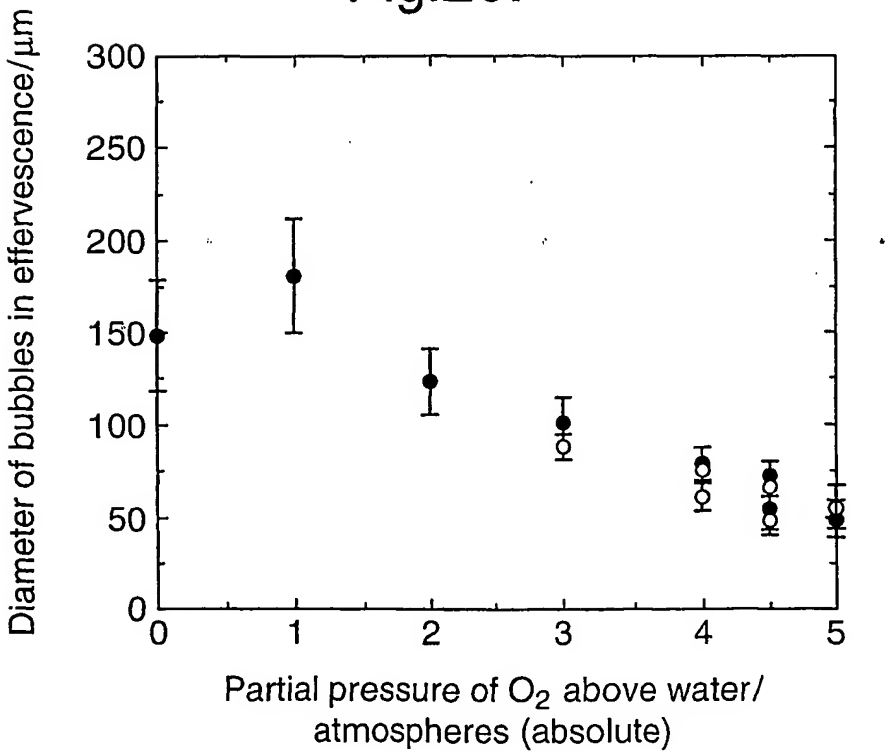

4
1
2
3
5
46
47
10
45
49
48

Fig.20.


Diameter of bubbles in effervescence/µm
300
250
200
150
100
50
0
0
1
2
3
4
5
Partial pressure of O_2 above water/
atmospheres (absolute)

INTERNATIONAL SEARCH REPORT

national Application No
PCT/EP 02/01810

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B65D83/32 B65D83/20 B65D83/28 B65D83/56 B65D83/66

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B65D A61H A23L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 069 098 A (FRANGOS ET AL.) 18 December 1962 (1962-12-18) column 1, line 11 - line 14 column 1, line 38 - line 61 column 2, line 13 - line 35 column 3, line 37 - line 42; figures 1,3	1,7-9, 12,13,19
A	US 5 143 288 A (KRUEGER RICHARD E ET AL) 1 September 1992 (1992-09-01) column 3, line 12 - line 16 column 5, line 18 - line 25	2,3,5,6
A	column 6, line 38 - line 44	7
A	EP 0 773 012 A (OREAL) 14 May 1997 (1997-05-14) claim 1; figure 1A	5,15

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 June 2002	21/06/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bridault, A

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 02/01810

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 116 370 A (SPITZER JOSEPH GEORGE ET AL) 26 September 1978 (1978-09-26) claim 23	14

INTERNATIONAL SEARCH REPORT

Information on patent family members

ıational Application No
PCT/EP 02/01810

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